FORM PTO-1390 (REV 10-94) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

DOCKET #: 4925-207PUS

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (If known, see 37 CFR 1.5): 10/049589

INTERNATIONAL APPLICATION NO	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/06951	20 September 1999	20 September 1999

TITLE OF INVENTION

A Method to Decrease Synchronization Time in Handover

APPLICANT(S) FOR DO/EO/US

Jaakko VIHRIÄLÄ

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [x] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3. [x] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [x] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [x] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [x] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [x] has been transmitted by the International Bureau.
   c. [] is not required, as the application was filed in the United States Receiving Office (RO/US)
6. [] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [x] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [x] are transmitted herewith (required only if not transmitted by the International Bureau). **(see Reply to Written Opinion)**
   b. [] have been transmitted by the International Bureau.
   c. [] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [] have not been made and will not be made.
8. [] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [x] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). **Unexecuted**
10. [] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. Below concern other document(s) or information included:

11. [x] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [x] A **FIRST** preliminary amendment.
    [] A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. [] A substitute specification.
15. [] A change of power of attorney and/or address letter.
16. [x] Other items or information *(specify)*: PCT Publication Sheet, Int'l Preliminary Examination Report, Written Opinion, Reply to Written Opinion, PCT Request, Information Concerning Elected Offices Notified of their Election, Notice Informing the Applicant of the Communication of the International Application to the Designated Offices, Notification of the Recording of a Change, Notification of Receipt of Record Copy

By Express Mail # EV052763520US

JC13 Rec'd PCT/PTO 13 FEB 2002

U.S. APPLICATION NO (If known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
10/04[illegible]89	PCT/EP99/06951	4925-207PUS

17.[x]The following fees are submitted.

Basic National Fee (37 CFR 1.492(a)(1)-(5)):
Search Report has been prepared by the EPO or JPO **$890.00**
International preliminary examination fee paid to USPTO (37 CFR 1.482)..... **$710.00**
No international preliminary examination fee paid to USPTO (37 CFR 1.482)
but international search fee paid to USPTO (37 CFR 1.445(a)(2))... ..... **$740.00**
Neither international preliminary examination fee (37 CFR 1.482)
nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$1040.00**
International preliminary examination fee paid to USPTO (37 CFR 1.482)
and all claims satisfied provisions of PCT Article 33(2)-(4) **$100.00**

			ENTER APPROPRIATE BASIC FEE AMOUNT =	**$**	890
Surcharge of **$130.00** for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				**$**	
Claims	Number Filed	Number Extra	Rate		
Total Claims	16 - 20 =		x **$18.00**	**$**	
Independent Claims	2 - 3 =		x **$84.00**	$	
Multiple dependent claim(s) (if applicable)			+ **$280.00**	**$**	
			TOTAL OF ABOVE CALCULATIONS =	**$**	890
Reduction of ½ for filing by small entity, if applicable.				**$**	
			SUBTOTAL =	**$**	890
Processing fee of **$130.00** for furnishing the English translation later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				**$**	
			TOTAL NATIONAL FEE =	**$**	890
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by the appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				**$**	
			TOTAL FEES ENCLOSED		$890
			Amount to be refunded:		**$**
			charged:		**$**

a. [x]One check in the amount of $ 890 to cover the above fee is enclosed.
b. [] Please charge my Deposit Account No. 03-2412 in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.
c. [x]The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-2412. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO
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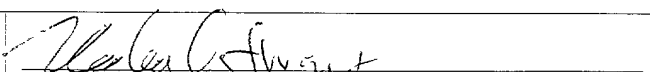

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By Express Mail # EV052763520US · February 13, 2002

Attorney Docket # 4925-207PUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of

Jaakko VIHRIÄLÄ

International Appln. No.: PCT/EP99/06951

International Filing Date: 20 September 1999

For: A Method to Decrease Synchronization Time in Handover

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231
BOX PCT

S I R:

Prior to examination of the above-identified application please amend the application as follows:

IN THE SPECIFICATION:

Page 6, delete lines 15 and 16, and substitute therefor the following paragraph:

-- Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are intended solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims.--

Page 14, delete lines 34 and 35.

Page 15, delete lines 1 to 4 and substitute therefor the following paragraph:

--Thus, while there have been shown and described and pointed out fundamental novel features of the present invention as applied to preferred embodiments thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices described and illustrated, and in their operation, and of the methods described may be made by those skilled in the art without departing from the spirit of the present invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Substitutions of elements from one described embodiment to another are also fully intended and contemplated. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.--.

Page 16, line 2, delete "Claims" and substitute therefor --What is claimed is:--.

IN THE CLAIMS:

Claims 5 to 6 and 13 to 16 have been amended to read as follows:

5. The method according to claim 3, wherein for each adjacent sector (CS1 to CS8) a plurality of start propagation values (SPV1_1 to SPV1_5) are used and an average of said plurality of start propagation values (SPV1_1 to SPV1_5) is used as the basis for said search strategy.

6. The method according to claim 5, wherein a distribution of said plurality of start propagation values (SPV1_1 to SPV1_5) is also used as the basis for said search strategy.

13. The device according to claim 11, wherein for each adjacent sector (CS1 to CS8) a plurality of start propagation values (SPV1_1 to SPV1_5) are stored in said database (14') and said updating means (17) is adapted to use an average of said plurality of start propagation values (SPV1_1 to SPV1_5) as the basis for said search strategy.

14. The device according to claim 13, wherein a distribution of said plurality of start propagation values (SPV1_1 to SPV1_5) is also used as the basis for said search strategy.

15. The device according to claim 9, wherein said search strategy is expanding window.

16. The device according to claim 9, wherein said search strategy is z-search.

REMARKS

This preliminary amendment is presented to place the application in proper form for examination. No new matter has been added. Early examination and favorable consideration of the above-identified application is earnestly solicited.

Attached hereto is a mark-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Version with markings to show changes made**".

Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
COHEN, PONTANI, LIEBERMAN & PAVANE

By: _____

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13 February 2002

AMENDMENTS TO THE SPECIFICATION AND CLAIMS SHOWING CHANGES

In the Claims:

5. The method according to claim 3, wherein for each adjacent sector (CS1 to CS8) a plurality of start propagation values (SPV1_1 to SPV1_5) are used and an [the] average [and distribution] of said plurality of start propagation values (SPV1_1 to SPV1_5) is [are] used as the basis for said search strategy.

6. The method according to claim 5, wherein a [also the] distribution of said plurality of start propagation values (SPV1_1 to SPV1_5) is also [are] used as the basis for said search strategy.

13. The device according to claim 11, wherein for each adjacent sector (CS1 to CS8) a plurality of start propagation values (SPV1_1 to SPV1_5) are stored in said database (14') and said updating means (17) is adapted to use an [the] average of said plurality of start propagation values (SPV1_1 to SPV1_5) [are used] as the basis for said search strategy.

14. The device according to claim 13 [5], wherein a [also the] distribution of said plurality of start propagation values (SPV1_1 to SPV1_5) is also [are] used as the basis for said search strategy.

15. The device according to claim 9 [1], wherein said search strategy is expanding window.

16. The device according to claim 9 [1], wherein said search strategy is z-search.

A METHOD TO DECREASE SYNCHRONIZATION TIME IN HANDOVER

Field of the invention

The present invention relates to a method for performing synchronisation of a mobile network device to a network control device of a radio network region, and to a network control device adapted to perform this method.

BACKGROUND OF THE INVENTION

A mobile network consists of a plurality of cells, each of which being provided with one or more base stations. When a mobile station moves from a first cell to a second cell, a handover (handoff) is performed by which the mobile station is disconnected from the first cell (i.e., the base station thereof) and connected to the second cell (i.e., the base station of the second cell). A handover is usually performed when the signal strength of the current base station drops and the signal strength of a neighbouring cell is greater than that of the current base station. It is noted that in CDMA (Code Division Multiple Access) based system usually the signal-to-noise ration SNR is used for deciding a handover.

In detail, the mobile station continually provides measurements of the signal strength from surrounding cells (i.e., base stations). The measurements are conducted when it is not transmitting or receiving (for example, during TDMA (Time Divisional Multiple Access) bursts), but can also be conducted while transmitting or receiving. A base station controller (BSC) or a mobile services switching center (MSC) collects these

measurements along with its knowledge of the quality of the existing link. In the case that it is decided that a handover is necessary, the BSC or MSC instructs the base station (BS) of the new cell to prepare a channel, takes note of the channel it has prepared, sends a message to the mobile telling it the channel to which to move, checks that the mobile appears on this channel, and then deactivates the old channel. The MSC may also decide to hand over mobiles due to traffic congestion. If there is one highly congested cell, the mobile stations in the cell who could also get coverage from other neighbouring cells might be instructed to hand over to reduce the load on the congested cell.

Besides this 'hard' handover in which the MS is switched from one channel to another, there is also a handover procedure, during which the MS is connected via both channels. This is called a 'soft' handover and serves to provide a better speech quality during the handover, since during the hard handover there is the risk that the connection is interrupted for a short time. A further kind of handover is the so-called 'softer' handover which is performed within the same cell.

Since the handover between two cells is not performed on a predetermined geographical location but depending on the signal strength, the distance between the MS and the new BS is not known. This is because the cell boundaries are not sharp but ambiguous due to shadowing and the like. Furthermore, the cell boundaries can also change in time due to cell breathing.

Thus, after a handover, the distance between the MS and the new BS is not known. Therefore, also a propagation delay due to the distance occurring between the MS and

the BS is unknown. However, it is important for the base station to know the propagation delay since otherwise interference and the like can occur.

In particular, the propagation delay is important for a synchronisation between uplink and downlink. For example, in GSM (Global System for Mobile Communications), the communication between the mobile station and the base station is performed in two different time slots. In particular, the transmission of uplink bursts is performed three time slots after transmission of downlink bursts. The time differences between the time slots are exactly defined. Therefore, in case of a great distance between the MS and the BS, the propagation delay of downlink bursts and uplink bursts has to be taken into account. Consequently, the MS needs to transmit a time period earlier than that defined only by the difference of the time slots. The information about how much earlier a burst has to be sent is conveyed to the MS by a signal TA (Timing Advance) which is generated by the BS or BSC according to the current propagation delay, wherein the value of TA corresponds to the round trip value of the propagation BS-MS-BS, i.e. twice of the propagation delay. The TA is dynamic and changes in time. Its current value is sent to the MS within an information channel (in detail, in the layer 1 header of each SACCH, i.e., Slow Associated Control Channel). The farther the MS is away from the BS, the larger is the required TA.

Thus, immediately after a handover has been performed, the propagation delay between the MS and the new BS is maximum since usually a handover is performed at the boundary of the corresponding cell. However, at this time the propagation delay is also not known.

Therefore, especially in case of a large cell, an incorrect TA value causes interference. Although in CDMA networks interference power decreases soon after completing the handover (because of a power control and the soft handover mentioned above), this interference occurs in connection with the handover and affects the communication quality greatly. Moreover, not only the current connection between the current MS and the BS is affected by such an interference, but also other connections are interfered since due to a wrong estimated propagation delay the transmission is shifted also into a neighbouring time slot such that the communication (between the BS and other MS's) effected via this time slot is affected.

It is to be noted that the propagation delay has been described with respect to GSM as an example, however, this problem also occurs in other kinds of radio networks.

In view of the above, it is necessary for providing a good connection that a correct propagation delay is detected as soon as possible.

Heretofore, a large matched filter was used for such a detection. Using a matched filter allows to detect the propagation delay although it is not known or uncertain at the beginning. However, the matched filter must be set such that it can detect a minimum propagation delay (i.e., a delay of zero) and a maximum propagation delay for the cell. That is, a huge extent of different possible propagation delays has to be considered. This requires a huge hardware amount. Furthermore, for the same reason a rather long search time has to be expected.

SUMMARY OF THE INVENTION

Thus, the object underlying the invention is to eliminate the above drawbacks of the prior art and to allow a fast detection of the propagation delay.

This object is solved by a method for performing synchronisation of a mobile network device to a network control device of a present radio network region after a handover. The method comprises the steps of detecting a source radio network region from which said handover of said mobile network device to said present radio network region has been performed, determining a start propagation delay value based on said detected source radio network region of said mobile station, and searching an actual propagation delay value by using a search strategy based on said determined start propagation delay value.

Furthermore, the above object is solved by a network control device of a present radio network region, comprising a detecting means for detecting a source radio network region from which a handover of a mobile network device to the present radio network region has been performed, a determining means for determining a start propagation delay value based on said detected source radio network region of said mobile station, and a search means for searching an actual propagation delay value by using a search strategy based on the determined start propagation delay value.

By the above method and network control device, the correct propagation delay can be detected very fast, since the values of the propagation delay from known

neighbouring cells are stored and used to generate a start value for the search of the correct propagation delay.

Moreover, only a short matched filter (MF) is required for the search of the correct propagation delay. Hence, the hardware amount can be decreased.

Furthermore, since the most probable delay is searched first, the search time is minimized, closed loop power control can be activated and the interference to the network is minimized thus leading to increased capacity of the network

Further advantageous developments are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more readily understood with reference to the accompanying drawings in which:

Fig. 1 shows a radio network to which the present embodiment is applicable,

Fig. 2 shows flowchart illustrating a method for synchronizing according to the present embodiment,

Fig. 3 shows a base station according to the present embodiment,

Fig. 4 shows the content of a database 14 of the base station according to the present embodiment,

Fig. 5 shows the content of a modified database 14' of the base station according to a modified embodiment, and

Figs. 6a to 6e examples for propagation delay search strategies used according to the embodiment and the modified embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In the following, a preferred embodiment of the invention is described in more detail with reference to the accompanying drawings.

Fig. 1 shows schematically a radio network consisting of a plurality of cells to which the present invention can be applied. In this example, only four cells CELL_1, CELL_2, CELL_3 and CELL_4 are shown. Each cell is subdivided in three sectors. Here, each sector represents an example for a radio network region. In case the cells are not subdivided, also a cell may be a radio network region.

In the following, a case is considered in which a handover of a mobile station (referred to by MS in the following) as an example for a mobile network device to the target sector CST is performed. The source sector (i.e., the sector from which the MS has been shifted to the target sector CST) is one of the neighbouring sectors CS1 to CS8.

In this network, for example a handover from sector CS4 (as the source sector) located in cell CELL_2 to the target sector CST is effected. This handover (HO) is indicated by the dotted arrow in Fig. 1.

It has to be noted that the cell boundaries are not sharp as shown in Fig. 1 but are ambiguous due to shadowing and can even change in time due to cell breathing. The phenomena of the so-called cell breathing is caused by changing transmission conditions due to weather conditions or varying loads in the cell.

As already described in the introductory part, a handover is initiated in case the signal strength of a connection between an MS and a base station (in the following referred to as BS) decreases below a certain level. Then, usually a handover to a cell (i.e., BS) with the greatest signal strength is performed. Thus, the position of the MS during the handover and, hence, the correct propagation delay between the MS and the new BS immediately after the handover is unknown.

According to the present embodiment, the correct propagation delay is searched by using a search strategy in which start value is used and which is then stepwise approximated to the real propagation delay value by performing iterations.

In particular, as the start value, a value is determined (or selected) based on the source cell or source sector. That is, a known past propagation value for an MS which has performed a handover from the same source cell or sector to the target cell or sector is used as a start value for the search.

The operation carried out according to the present embodiment is described by referring to a flow chart shown in Fig. 2.

First, the source sector is detected in step S2. This can be effected such that the MS sends a corresponding information after a connection between the new BS and the MS has been established.

Another way of detecting the source sector of the MS performing a handover could be effected such that the source BS (e.g., the BS of sector CD4 in cell CELL_2) transmits a corresponding information from to the BS of the target sector CST.

Based on this information, a start value for conducting a search for the correct current propagation delay is searched. This is effected by accessing a database in step S2.

In this database, propagation delay values corresponding to source sectors are stored. According to this embodiment, one propagation delay start value is stored for each source sector. An example for the content of such a database is shown in Fig. 4. The values are updated such that by the database always start values are provided which are close to the actual propagation delay value. Updating of the propagation delay start values in the database is described later in the description.

The database could reside in every BS of each sector or in a radio network control device (RNC). The required size of memory is quite small: Assuming that there are 8 possible source sectors each having 512 chip delay uncertainty (in case spread spectrum is used) and an matched filter (MF) length of 32 chips. Then, the required amount of memory per BS (or sector) is 8 x 512/32 = 128 words.

Thus, the corresponding start value is acquired from the database in step S3. Then, in step S4 a search for the correct current propagation delay is conducted based on the acquired start value.

The search strategy used for searching the propagation value can be z-search or expanding window, for example. Examples for such search strategies are shown in Figs. 6a to 6e. In all figures, the uncertainty refers to the delay.

Figs. 6a to 6b illustrate examples for the z-search. This search is appropriate if the probability density function of the expected delay (uncertainty) is even distributed. According to Fig. 6a, the search is started from a start point at the edge of the interval, whereas according to Fig. 6b the search is started from a centre point of the search interval. In both cases, the search is conducted continuously over the interval. According to Fig. 6c, the z-search is started from the centre, but conducted discontinuously, as indicated by the hatched lines.

Figs. 6d and 6e show examples for expanding window. According to this strategy, the search is started from a certain starting point. If the signal is not found at this delay, the next one is checked and this is continued until at some point, the search direction is inverted. According to this search, the search interval is increased at every turn of the search direction. The expanding window search strategy is the optimal search strategy if the probability function of the expected delay is gaussian (with centre at starting point). Broken expanding window (as shown in Fig. 6e) performs better than the continuous expanding window search strategy shown in Fig. 6d if it is known that the probability of

detection is always 1 (however, in practice, this is usually not the case).

The search can be conducted using a short matched filter since the uncertainty of the propagation delay value is small.

After detecting the current propagation delay value, this value is used for the communication between the mobile station and the base station, as indicated in step S5.

After this, the database is updated by using the detected current propagation delay value in step S6 which is described later.

The method described above can be executed by the base station of the target sector CST in cell CELL_3. This base station is schematically illustrated in Fig. 3. For simplifying the illustration, only the means important for the present embodiment are shown.

The base station of the target sector CST is denoted by reference numeral 1. The base station 1 comprises a source cell detector 11 which is adapted to detect the source cell of a mobile station just having performed a handover, i.e., to execute step S1 described above.

The information related to the detected source cell (in the above example, sector CS4 of cell CELL_2) is supplied to a start value determining means 12. The start value determining means determines a start value for the propagation delay search by referring to a database 14. That is, the start value determining means performs the steps S2 and S3 described above.

The detected start value is supplied to a propagation delay search means 13. This means carries out the search for the propagation delay value (e.g., z-search or expanding window) described above. Thus, it serves to execute step S4.

The detected propagation value is supplied to a communication means 15 which performs communication with the mobile station 2 via an antenna 16. The communication means 15 uses the detected propagation value and, thus, executes step S5.

It has to be noted that the source cell detector 11, the start value determining means 12 and the propagation delay search means 13 can be combined to a single controller. This controller can comprise a CPU (central processing unit), a ROM (read-only memory) in which the steps according to Fig. 2 are stored as a program, and a RAM (random access memory) as a working memory. The data base 14 is preferably a non-volatile memory, for example an EEPROM (electrically erasable, programmable read-only memory) or the like.

For the propagation delay start values stored in the database 14 it is necessary that these start values are as close to the real propagation delay value as possible because then the search can be effected in a very short time. Thus, the propagation delay start values should be updated in accordance with the current communication conditions.

The base station 1 shown in Fig. 1 comprises an updating means 17 adapted to perform the updating of the database 14. Hence, the current propagation delay value CPV is also supplied to the updating means 17 which can access

the database 14. According to this embodiment, the updating means can be a simple memory access means which can read and write data to a predetermined address. Therefore, the database 14 is preferably accessible from two sources, i.e., a non-volatile dual-port RAM or the like.

As an alternative, the updating means 17 can also be integrated in the single controller mentioned above such that the database needs to be accessed via one port only.

According to the present embodiment, updating of the database is effected by using propagation delays which were detected immediately before. That is, each time a new propagation delay has been detected, this new propagation delay is written into the database 14 instead of the start value which has been used for detecting the propagation value.

By referring to the example described above, this means that after detecting the current propagation value for a handover from sector CS4 to CST, this current propagation value is written in the data base 14 in the place of the start value SPV4 corresponding to sector CS4.

By this measure, the search is always based on the real propagation delay which was detected immediately before the current handover. Thus, the start value is very close to the current propagation value.

As an alternative, the history of the detected propagation delay can be considered. Such a measure is described with respect to a modification of the above-described embodiment hereinafter.

In detail, a predetermined number of past propagation values can be stored and be used in order to create a start value by calculating the average value thereof. For carrying out this measure, the database 14 has to be modified such that for each sector a predetermined number (for example, 5) of propagation delay values are stored. Such a modified database 14' is shown in Fig. 5, wherein for each sector five start values are stored. For simplifying the illustration, only three sectors are shown. Updating of the database 14' has to be effected such that always the oldest propagation delay value is replaced by the new one. Thus, the updating means 17 has to be correspondingly modified.

According to this modification of the preferred embodiment, it can be avoided that sudden and short-time changes in the communication conditions lead to unrealistic start values.

According to the embodiments described above the method for synchronisation is performed in a base station BS. However, the BS is only an example for a network control device. For example, the method can also be performed in a corresponding base station controller BSC controlling a plurality of BS's or in a mobile services switching center MSC controlling a plurality of BSC's. Such an arrangement is useful in case an existing network should be provided with the method according to the invention. Thus, if the method is carried out in only a few central network control devices, it is not necessary to update each base station. Hence, costs for updating a radio network can be reduced.

The above description and accompanying drawings only illustrate the present invention by way of example. Thus,

the embodiments of the invention may vary within the scope of the attached claims. Furthermore, it is possible to combine the above-described embodiments (i.e., the preferred embodiment and the modification thereof).

Claims

1. A method for performing synchronisation of a mobile network device (**2**) to a network control device (**1**) of a present radio network region (**CST**), comprising the steps of

detecting (**S1**) a source radio network region (**CS1 to CS8**) from which a handover of said mobile network device (**2**) to said present radio network region (**CST**) has been performed,

determining (**S2, S3**) a start propagation delay value (**SPV1 to SPV8; SPV1_1 to SPV1_5**) based on said detected source radio network region (**CS1 to CS8**) of said mobile station (**2**), and

searching (**S4**) an actual propagation delay value by using a search strategy based on said determined start propagation delay value (**SPV1 to SPV8; SPV1_1 to SPV1_5**).

2. The method according to claim 1, wherein for a plurality of adjacent sectors (**CS1 to CS8**) start propagation delay values (**SPV1 to SPV8; SPV1_1 to SPV1_5**) are stored in a database (**14; 14'**).

3. The method according to claim 2, further comprising the step of

updating (**S6**) said database (**14; 14'**) with said searched actual propagation delay value after performing said search step.

4. The method according to claim 3, wherein for each adjacent sector (**CS1 to CS8**) one start propagation value (**SPV1 to SPV8**) is stored.

5. The method according to claim 3, wherein for each adjacent sector (**CS1 to CS8**) a plurality of start propagation values (**SPV1_1 to SPV1_5**) are used and the average and distribution of said plurality of start propagation values (**SPV1_1 to SPV1_5**) are used as the basis for said search strategy.

6. The method according to claim 5, wherein also the distribution said plurality of start propagation values (**SPV1_1 to SPV1_5**) are used as the basis for said search strategy.

7. The method according to claim 1, wherein said search strategy is expanding window.

8. The method according to claim 1, wherein said search strategy is z-search.

9. A network control device of a present radio network region (**CST**), comprising

a detecting means (**11**) for detecting a source radio network region (**CS1 - CS8**) from which a handover of a mobile network device (**2**) to the present radio network region (**CST**) has been performed,

a determining means (**12, 14**) for determining a start propagation delay value (**SPV1 to SPV8; SPV1_1 to SPV1_5**) based on said detected source radio network region (**CS1 to CS8**) of said mobile station (**2**), and

a search means (**13**) for searching an actual propagation delay value by using a search strategy based on the determined start propagation delay value (**SPV1 to SPV8; SPV1_1 to SPV1_5**).

10. The device according to claim 9, further comprising a database (**14; 14'**) in which for a plurality of adjacent sectors (**CS1 to CS8**) start propagation delay values (**SPV1 to SPV8; SPV1_1 to SPV1_5**) are stored, wherein said determining means (**12**) accesses said database (**14**).

11. The device according to claim 10, further comprising an updating means (**17**) for updating said database with the current propagation delay value detected by said search means (**13**).

12. The device according to claim 11, wherein for each adjacent sector (**CS1 to CS8**) one start propagation value (**SPV1 to SPV8**) is stored in said database (**14**).

13. The device according to claim 11, wherein for each adjacent sector (**CS1 to CS8**) a plurality of start propagation values (**SPV1_1 to SPV1_5**) are stored in said database (**14'**) and said updating means (**17**) is adapted to use the average of said plurality of start propagation values (**SPV1_1 to SPV1_5**) are used as the basis for said search strategy.

14. The device according to claim 5, wherein also the distribution said plurality of start propagation values (**SPV1_1 to SPV1_5**) are used as the basis for said search strategy.

15. The device according to claim 1, wherein said search strategy is expanding window.

16. The device according to claim 1, wherein said search strategy is z-search.

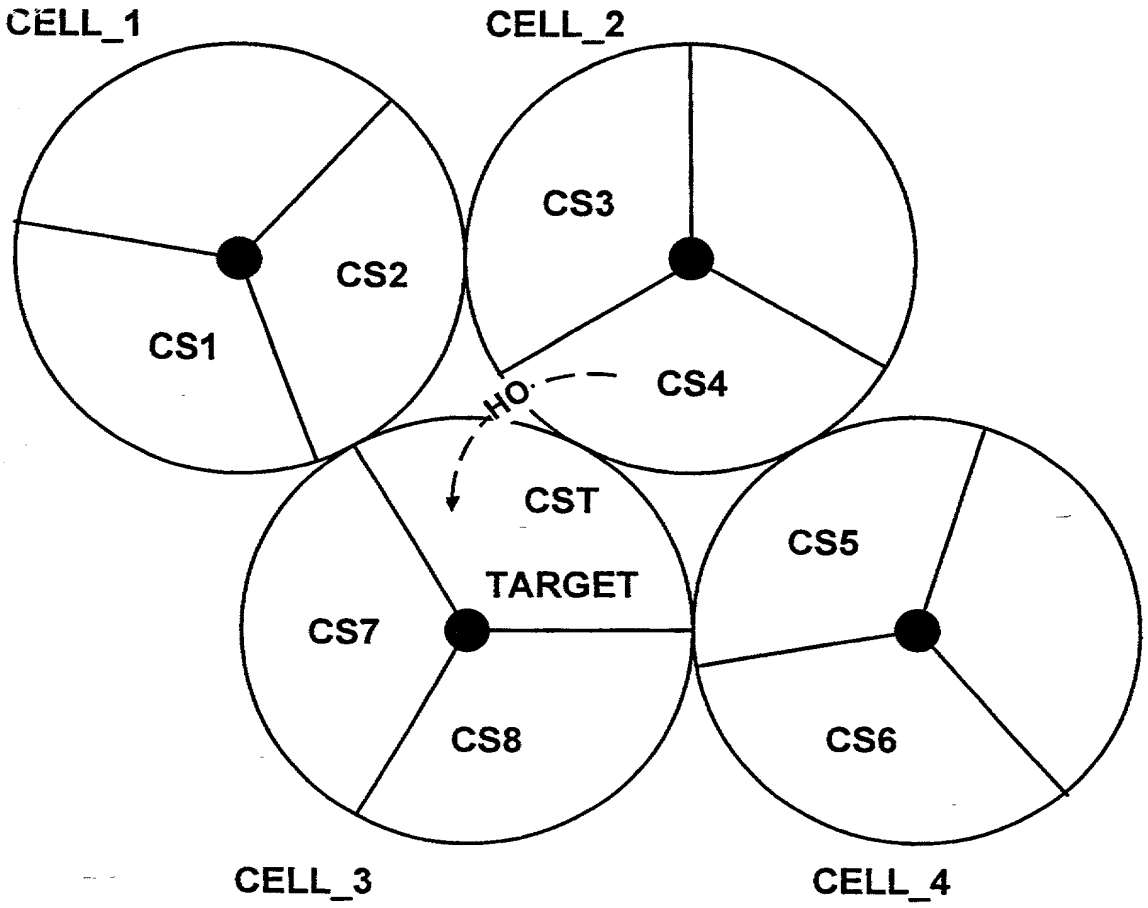

CELL_1
CELL_2
CS1
CS2
CS3
CS4
HO
CST
TARGET
CS5
CS6
CS7
CS8
CELL_3
CELL_4

FIG. 1

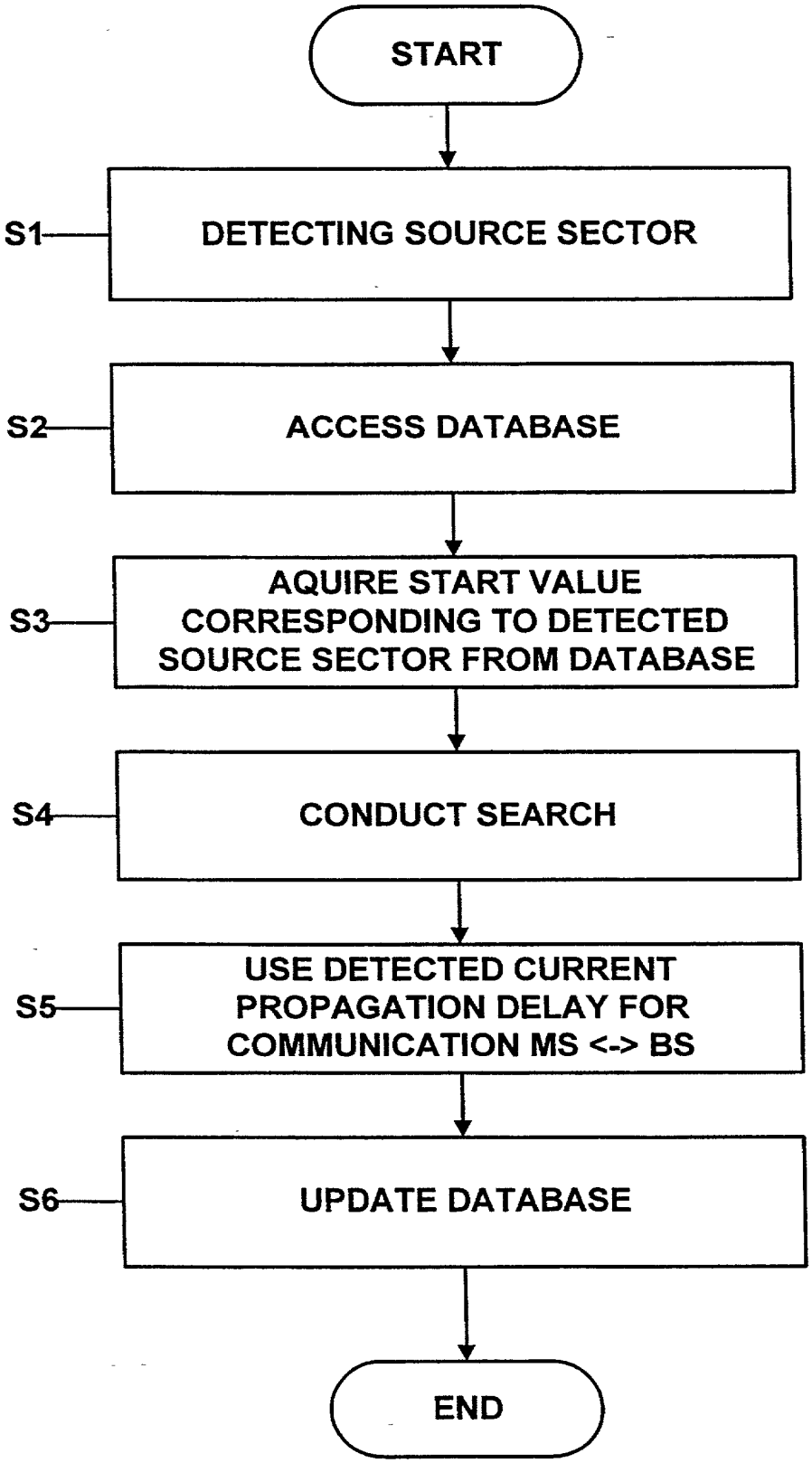

START
S1
DETECTING SOURCE SECTOR
S2
ACCESS DATABASE
S3
AQUIRE START VALUE CORRESPONDING TO DETECTED SOURCE SECTOR FROM DATABASE
S4
CONDUCT SEARCH
S5
USE DETECTED CURRENT PROPAGATION DELAY FOR COMMUNICATION MS <-> BS
S6
UPDATE DATABASE
END

FIG. 2

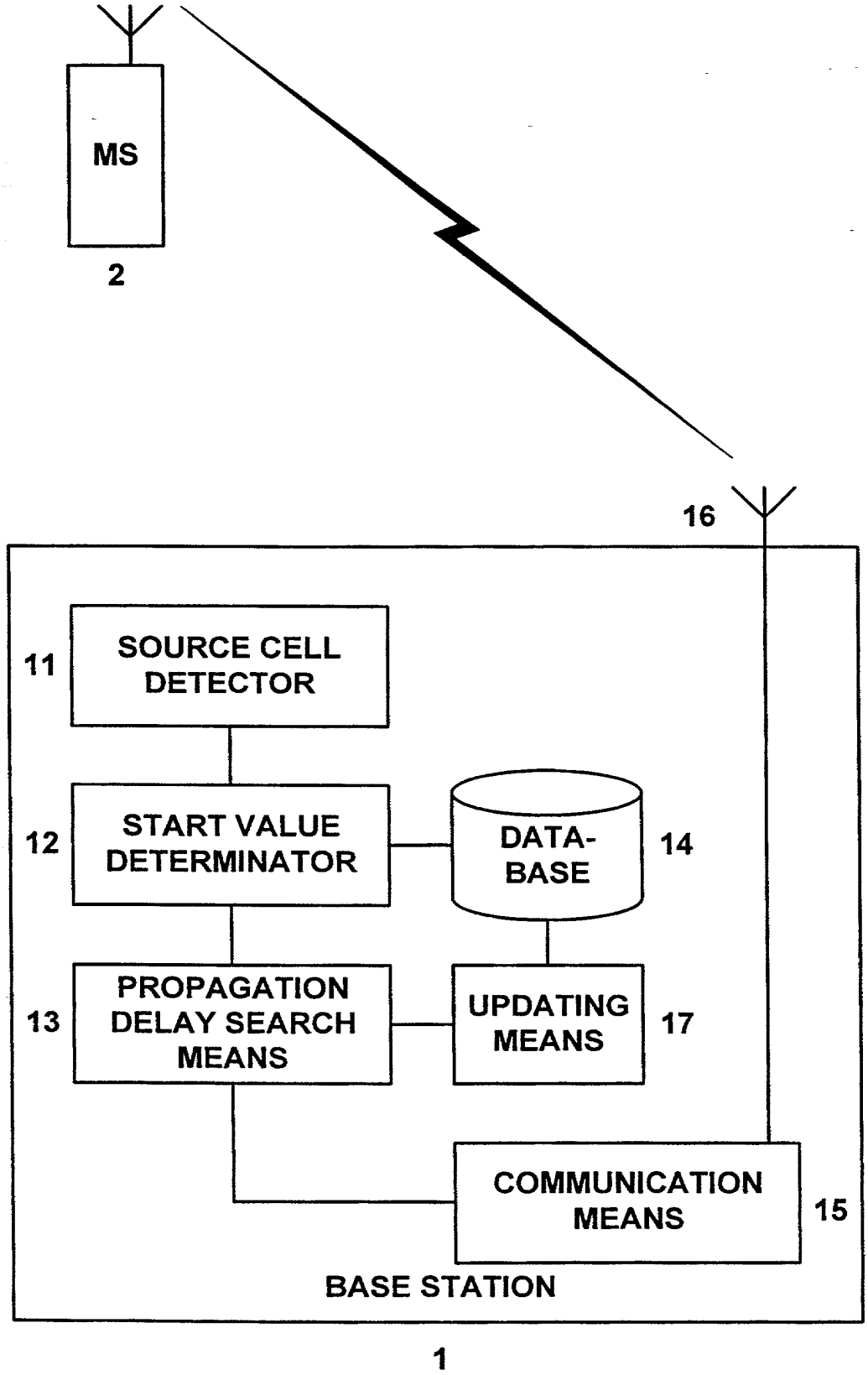

MS
2
16
11
SOURCE CELL DETECTOR
12
START VALUE DETERMINATOR
DATA-BASE
14
13
PROPAGATION DELAY SEARCH MEANS
UPDATING MEANS
17
COMMUNICATION MEANS
15
BASE STATION
1

FIG. 3

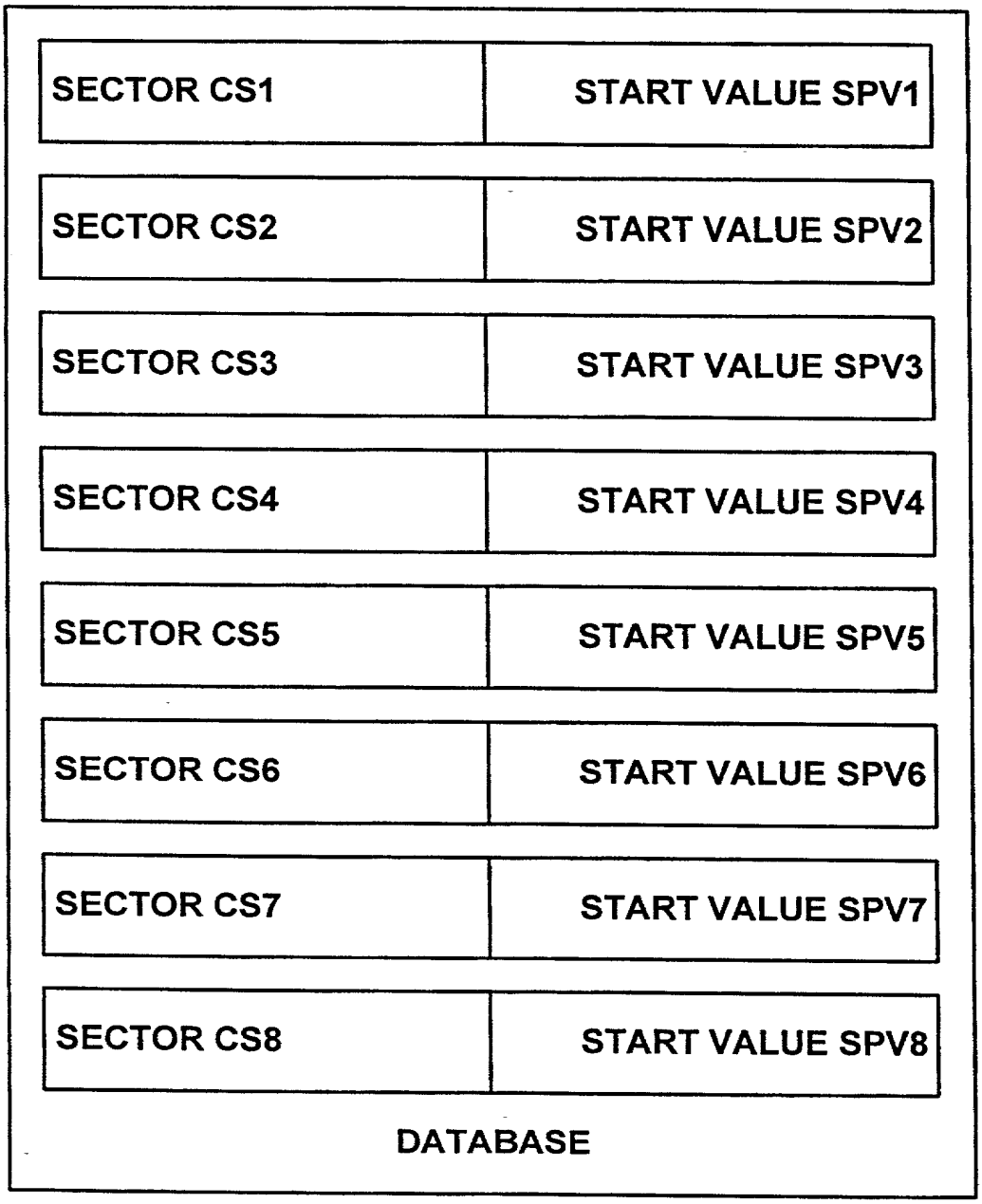
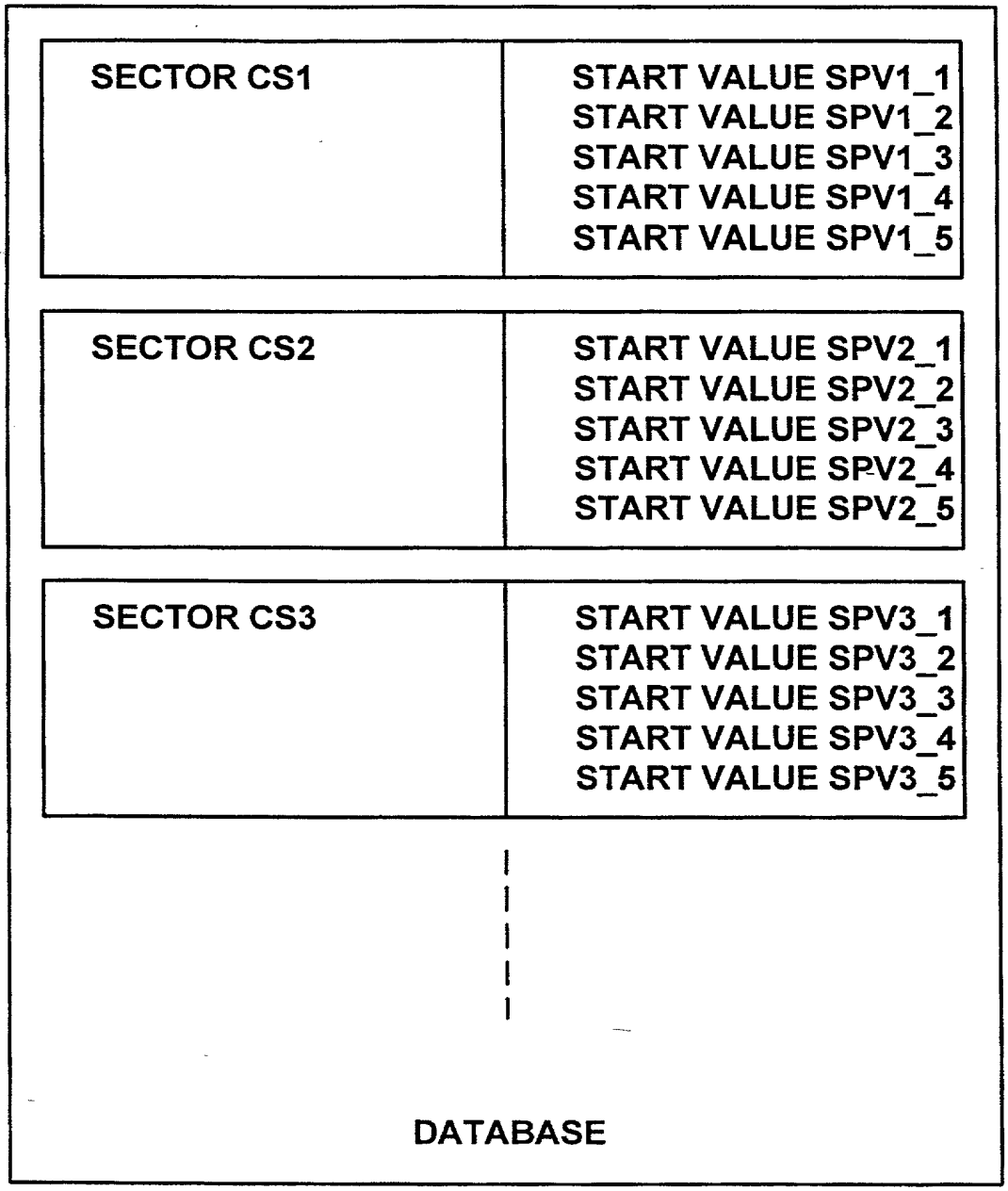

SECTOR CS1
START VALUE SPV1
SECTOR CS2
START VALUE SPV2
SECTOR CS3
START VALUE SPV3
SECTOR CS4
START VALUE SPV4
SECTOR CS5
START VALUE SPV5
SECTOR CS6
START VALUE SPV6
SECTOR CS7
START VALUE SPV7
SECTOR CS8
START VALUE SPV8
DATABASE
14

FIG. 4


SECTOR CS1
START VALUE SPV1_1
START VALUE SPV1_2
START VALUE SPV1_3
START VALUE SPV1_4
START VALUE SPV1_5
SECTOR CS2
START VALUE SPV2_1
START VALUE SPV2_2
START VALUE SPV2_3
START VALUE SPV2_4
START VALUE SPV2_5
SECTOR CS3
START VALUE SPV3_1
START VALUE SPV3_2
START VALUE SPV3_3
START VALUE SPV3_4
START VALUE SPV3_5
DATABASE

14'

FIG. 5

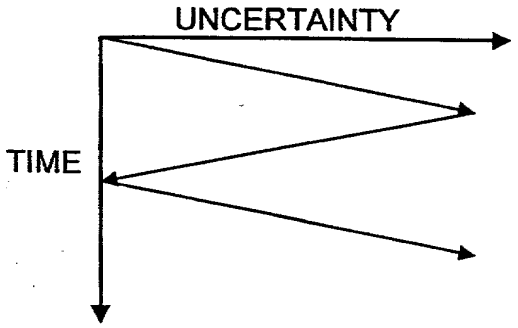


FIG. 6a

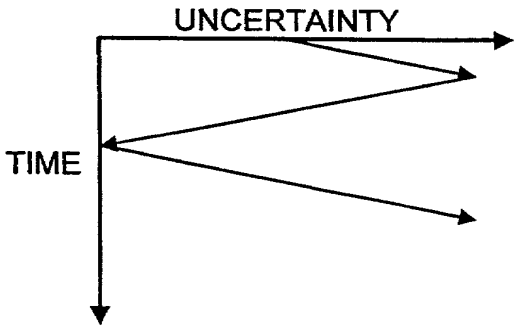


FIG. 6b

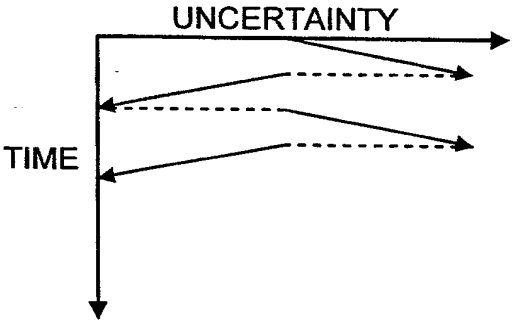


FIG. 6c

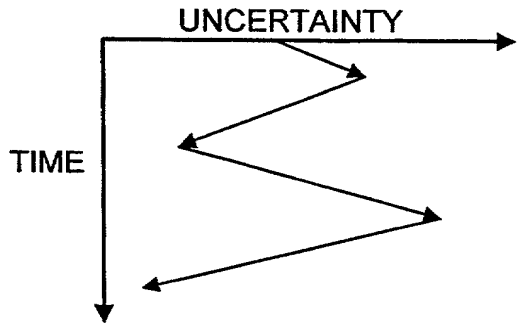


FIG. 6d

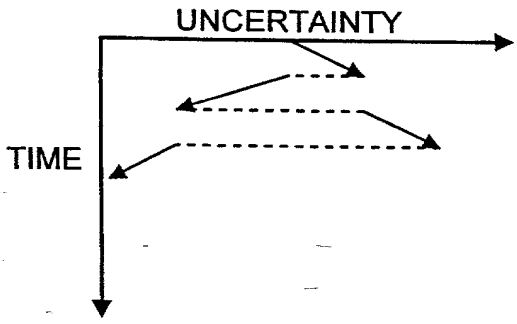


FIG. 6e

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
Includes Reference to PCT International Applications

Attorney's Docket No. **4925-207PUS**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

A METHOD TO DECREASE SYNCHRONIZATION TIME IN HANDOVER

the specification of which (check only one item below)

[] is attached hereto

[] was filed as United States application

Serial No. _

on _

and was amended

on _ (if applicable).

[x] was filed as PCT international application

Number PCT/EP99/06951

on 20 September 1999

and was amended under PCT Article 19

on _ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of the application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

PRIOR FOREIGN/PCT APPLICATIONS AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

Country (if PCT, indicate "PCT")	Application Number	Date of Filing (day, month, year)	Priority Claimed Under 35 U.S.C. 119	
			[] YES	[] NO
PCT	PCT/EP99/06951	20 September 1999	[x] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO

U.S. DEPARTMENT OF COMMERCE Patent and Trademark Office
Equivalent to PTO 139 (REV. 10 83)

Combined Declaration for Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)	Attorney's Docket No. **4925-207PUS**

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS *(check one)*		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED
PCT APPLICATIONS DESIGNATING THE U.S.				
PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED *(if any)*		
PCT/EP99/06951	20 September 1999			X

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (*List name and registration number*)

MYRON COHEN, Reg. No. 17,358; THOMAS C. PONTANI, Reg. No. 29,763; LANCE J. LIEBERMAN, Reg. No. 28,437; MARTIN B. PAVANE, Reg. No. 28,337; MICHAEL C. STUART, Reg. No. 35,698; KLAUS P. STOFFEL, Reg. No. ~~31,668~~; EDWARD WEISZ, Reg. No. 37,257; VINCENT M. FAZZARI, Reg. No. 26,879; JULIA S. KIM, Reg. No. 36,567; ALFRED FROEBRICH, Reg. No. 38,887; ALFRED H. HEMINGWAY, JR , Reg. No. 26,736; KENT H. CHENG, Reg. No. 33,849; YUNLING REN, Reg. No. 47,019; ROGER S. THOMPSON, Reg. No. 29,594; BRICE FALLER, Reg. No. 29,532; DAVID J. ROSENBLUM; Reg. No. 37,709; TONY CHEN, Reg. No. 44,607; TEODOR J. HOLMBERG, Reg. No. 50,140.

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202	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE, CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

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Combined Declaration for Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications)	**Attorney's Docket No.** **4925-207PUS**

2 0 3	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE, CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201 [illegible signature]	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE 7 Mar 2002	DATE	DATE